INDOOR AIR QUALITY ASSESSMENT

Putnam Vocational Center
1300 State Street
Springfield, Massachusetts

Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health Assessment

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Background/Introduction

At the request of Lynn Rose from the Western Massachusetts Coalition for Occupational Safety and Health (MassCOSH), the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health Assessment (BEHA) was asked to provide assistance and consultation regarding indoor air quality at the Putnam Vocational Center, 1300 State Street, Springfield, Massachusetts.

On May 24, 2000, a visit was made to this school by Michael Feeney, Chief of Emergency Response/Indoor Air Quality (ER/IAQ), BEHA, to conduct an indoor air quality assessment. Mr. Feeney was accompanied by Cory Holmes, Environmental Analyst, ER/IAQ and Suzan Donahue, Research Assistant for the ER/IAQ program. BEHA staff were accompanied at various times by Lynn Rose, Chuck Aycock, Maureen Leahy, Head Nurse, Joao Alves, and Holly Garvey. Due to the size of the school, subsequent visits were made on May 25 and June 12, 2000 to complete the inspection.

The school is a three story brick building constructed in 1940. Additions, referred to as the B/C-wing, the D/E-wing and the F/G-wing, were constructed in 1950. In 1986, the H-wing was added. The original building (A-wing) contains mostly general classrooms, art rooms and offices. There is also a small kitchen area called the "Cappuccino Café" in the basement level. B-wing contains the ROTC, small appliance repair, a heating ventilation and air conditioning (HVAC) shop, and health assistants' offices. C-wing consists of cosmetology, culinary arts, "Putnam's Pride" restaurant, electronics and science/drafting classrooms. D-wing contains a print shop, commercial art/photography program and the library/media center. E-wing contains building/property maintenance, which is being discontinued and will not be offered during the 2000-2001 school year. E-wing also contains a horticulture program area and general classrooms. F-wing consists of the gymnasium and health center offices. G-wing consists mainly of the auditorium and a cafeteria. H-wing contains the auto-body, auto mechanics, carpentry, and sheet metal shops as well as administrative offices.

Methods

Air tests for carbon dioxide were taken with the Telaire, Carbon Dioxide Monitor and tests for temperature and relative humidity were taken with the Mannix, TH Pen PTH8708 Thermo-Hygrometer. Screening for total volatile organic compounds (TVOCs) was conducted in the vocational education wing using an HNu Systems, Photo Ionization Detector (PID) during the May 24th visit. Outdoor background TVOC measurements were taken for comparison to indoor levels. Noise levels in the carpentry shop were measured using the Extech Instruments, Digital Sound Level Meter, model # 407727.

Results

This school has a student population of approximately 1,525 and a staff of 260. The tests were taken during normal operations at the school. Test results appear in Tables 1-21.

Discussion

Ventilation

It can be seen from the tables that carbon dioxide levels were elevated above 800 parts per million parts of air (ppm) in fifty-seven of the one hundred thirty-six areas surveyed over the course of the three visits. It should be noted that many areas had open windows and/or doors that can greatly contribute to reduced carbon dioxide levels. Two-thirds (42 out 63) of A-wing and five of eight areas in B-wing had carbon dioxide levels above 800 ppm (many with windows open), which is indicative of an overall ventilation problem in these building sections.

Fresh air in classrooms is supplied by a unit ventilator (univent) system (see Pictures 1 & 2). Univents draw air from outdoors through a fresh air intake located on the exterior walls of the building (see Picture 3) and return air through an air intake located at the base of each unit (see Figure 1). Fresh air and return air are mixed, filtered, heated and provided to classrooms through a fresh air diffuser located in the top of the unit. Univents were deactivated in the majority of classrooms surveyed (see Tables). Obstructions to airflow, such as books, papers and posters on top of univents, as well as bookcases, tables and desks in front of univent returns, were seen in a number of classrooms. To function as designed, univents and univent returns must remain free of obstructions. Importantly, these units must be activated and allowed to operate during hours of school occupation. A-wing univents appear to be original equipment, approximately 60 years old. Univents were opened in several of these classrooms. None of the univents inspected in A-wing classrooms contained filters (see Picture 4).

Fresh air supply in large volume areas (e.g., shops, gymnasium, auditorium etc.) is provided by ceiling mounted air handling units (AHUs) that are connected to ducted air diffusers. A number of AHUs were found deactivated. Several areas (offices) do not have mechanical fresh air supplies, but rather, rely on the opening of windows to provide fresh air.

Exhaust ventilation in A-wing was originally provided by ducted natural/gravity feed vents. Airflow was controlled by louvers, which were opened/closed by a draw chain-pulley system (see Picture 5). The louvers could be set at a desired angle by setting the draw chain in a locking mechanism. It appears however, that the exhaust system has been abandoned. Exhaust vent louvers were closed/damaged in many classrooms, some vents were also missing grates and/or pull chains. Exhaust vents were not drawing air in many classrooms, and in some cases, were backdrafting (air coming out of the vent). An examination of the roof found likely termini of gravity vents missing or sealed with plywood.

The configuration of the exhaust ventilation system in the newer classrooms could not be positively determined. Many areas contained ceiling mounted exhaust vents, but no airflow was detected during the visit. The shops in H wing were also equipped with ceiling mounted exhaust vents. Exhaust vent motors exist on the rooftop of newer wings. A number of these exhaust vents were deactivated. Approximately half of these motors appeared to be operating (see Table 21 under "Roof Notes"). Without a functioning exhaust system normally occurring environmental pollutants can build up and lead to indoor air complaints.

Exhaust ventilation for specialized shop activities are addressed later in this report (See Other Concerns). The purpose of these exhaust ventilation systems is to remove dust, fumes, vapors or gasses generated by the shop activities, which is a specialized purpose different than general exhaust ventilation.

To maximize air exchange, the BEHA recommends that both supply and exhaust ventilation operate continuously during periods of school occupancy. In order to have proper ventilation with a mechanical supply and exhaust system, the systems must be balanced to provide an adequate amount of fresh air to the interior of a room while removing stale air from the room. The date of the last balancing of these systems was not available at the time of the assessment.

The Massachusetts Building Code requires a minimum ventilation rate of 15 cubic feet per minute (cfm) per occupant of fresh outside air or have openable windows in each room (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens, a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week, based on a time-weighted average (OSHA, 1997).

The Department of Public Health uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches.

Temperature readings ranged from 68° F to 78° F, which is close to the BEHA recommended guidelines. The BEHA recommends that indoor air temperatures be maintained in a range between 70 ° F to 78 ° F in order to provide for the comfort of building occupants. A number of temperature complaints were made by building occupants, which may indicate a problem with the heating system or thermostatic control. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply. Temperature control is difficult in an old building without a functioning ventilation system.

As a general observation, the ventilation systems in the building appear to have thermostats set to deactivate univents at normal operating temperatures. The health center department's thermostats were examined. Each thermostat was set to activate the ceiling mounted vents at 50 ° F. Adjusting the setting of this thermostat activated the HVAC system in this area. The occupants of the nurse's office nearest the elevator complained of cold air from the univent during winter months. The addition of the H wing and elevator shaft sealed the univent fresh air intake in the nursing office. On the roof in the elevator shaft is a northwest-facing vent (see Picture 6) that appears to be the fresh air intake for this univent. The cover to this exterior vent has fixed louvers. Cold weather systems travelling through New England in the winter generally produce a northwest wind. If a northwest wind is present, the configuration of this vent allows for cold air to be forced down this vent shaft to the univent. With the univent motor deactivated, cold air can backdraft into this area. With the installation of the ceiling mounted air diffuser, the use of the univent system to provide heat and fresh air was rendered redundant.

The relative humidity in the building was outside of the BEHA recommended comfort range in a number of areas sampled. Relative humidity measurements ranged from 25 to 67 percent. The BEHA recommends that indoor air relative humidity be maintained in a range of 40 to 60 percent for comfort purposes. Relative humidity levels in the building would be expected to drop during the winter months due to heating. The sensation of dryness and irritation is common in a low relative humidity environment. Low relative humidity is a very common problem during the heating season in the northeast part of the United States. The May 24th assessment occurred on a day with periods of heavy precipitation. With the combination of inactive ventilation systems and open exterior doors and windows, relative humidity levels can become elevated indoors. While temperature is mainly a comfort issue, relative humidity in excess of 70% can provide an environment for mold and fungal growth (ASHRAE, 1989). During periods of high relative humidity (late spring/summer months), windows and exterior doors should be closed to keep moisture out; in addition, AHUs, univents and exhaust ventilation should be activated to control moist air in the building.

Microbial/Moisture Concerns

A number of interior areas of the building had signs of water damage. Water damaged wall/ceiling plaster was noted throughout the building (see Picture 7). Water damaged ceiling tiles were seen in a number of areas, which is evidence of historic roof or plumbing leaks. The women's locker room has water damaged ceiling plaster, which corresponds to the water damaged gymnasium floor beneath a water fountain (see Picture 8). Water damaged wood, plaster and ceiling tiles can serve as a mold growth medium, and should be replaced after a water leak is discovered. Possible mold growth was observed on ceiling tiles in the gym. The HVAC shop was noted by BEHA staff to have water pooling on the floor from an active water leak during the May 25th visit. Active roof leaks were reported in A-302, the Assistant Principal's office and E-305.

Water intrusion was evident by the presence of efflorescence (e.g., mineral deposits) on both interior and exterior brickwork (see Pictures 9 and 10). Efflorescence is a characteristic sign of water damage to brick and mortar, but it is not mold growth. As moisture penetrates and works its way through mortar around brick, water-soluble compounds in bricks and mortar dissolve, creating a solution. As this solution moves to the surface of the brick or mortar, the water evaporates, leaving behind white, powdery mineral deposits. Water damage was especially prevalent in the auditorium and locker rooms.

The manner by which the Putnam complex was built led to a design of the roof system that tends to result in water pooling. The front sections of the building consist of wings that form "courtyards" that are enclosed on three sides (see Picture 11). The interiors of these courtyards were filled with low-lying one story roofs (e.g., the roof over the boiler area). Wind and accompanying debris enter the courtyard and tends to swirl, leading to the accumulation of leaves, paper, trash or other debris on the low lying roofs. This debris subsequently collects around roof drains to form small dams that hinder the free flow of rainwater into drains. Over time, debris can enter the roof drainpipe, leading to clogging and back up of water (see Picture 12). Also hindering drainage in some lower-lying roofs is the placement of drains. In several cases, drains were located in the highest point of the roof. In some cases, the roof drain strainer was removed, allowing the accumulation of material in roof drains. Accumulation of materials can lead to blockage and water back up, leading to pooling. Standing water was noted in a number of areas on the roof, including under air handling equipment (see Pictures 13 & 14).

During operation of the AHUs, there is a potential for the entrainment of moisture into the HVAC system, which can lead to mold growth within the unit, and then in turn distributed to occupied areas via ductwork.

The collection of water and its subsequent freezing and thawing during winter months can lead to roof leaks resulting in water penetration into the interior of the building. Pooling water can also become stagnant, which can lead to mold and bacterial growth, resulting in unpleasant odors and providing a breeding ground for mosquitoes.

Water accumulation was also noted against the building in lower areas. As an example, several inches of water were seen at the bottom of a ramp leading into the basement storage area (see Picture 15). Although a drain was observed, water had collected in the area and had entered the basement under the door. The door in this area showed signs of repeated water damage. Pooling water was also noted in the first floor men's restroom near B-100.

Opportunity for water penetration through the building envelope exists along the exterior wall/tarmac junction. Plants were noted growing in this area (see Picture 16). Water can gather in the wall/tarmac seam. Freezing and thawing of gathered water can result in damage to the exterior wall, which can lead to in water penetration into the building.

Water vapor was observed collecting inside the double-paned window glass. This indicates that the window's water seal is no longer intact. Broken windows were also noted (see Tables). Water penetration through window frames can lead to mold growth under certain conditions. Repairs of window leaks are necessary to prevent further water penetration. Repeated water damage can result in mold colonization of window frames, curtains and items stored on windowsills. A number of areas had window-mounted air conditioning units. In A-006 spaces were observed around the air-conditioning unit, which can provide a means of water penetration into the building.

Plants were noted in several classrooms. Plants can be a source of pollen and mold, which can be a respiratory irritant to some individuals. Plants should be properly maintained and equipped with drip pans. Plants should also be located away from univents to prevent the aerosolization of dirt, pollen or mold. Several classrooms contained plants in window planters. Window planters are designed to be mounted on the outside of windows and usually do not have drip pans. The lack of drip pans can lead to water pooling and mold growth on windowsills when used indoors. Windowsills, can be potentially colonized by mold growth and serve as a source of mold odor. Several classrooms had plants without drip pans resting on newspaper or other paper material. If this material becomes wet repeatedly, it can also become colonized by mold.

The main office contained a water stained carpet. The American Conference of Governmental Industrial Hygienists (ACGIH) recommends that carpeting be dried with fans and heating within 24 hours of becoming wet (ACGIH, 1989). If carpets are not dried within this time frame, mold growth may occur. Once mold has colonized porous materials, they are difficult to clean and should be removed.

The cafeteria has a business office located in the rear of the kitchen. This office does not have a fresh air supply. An inoperative exhaust fan exists in an interior wall (see Picture 17). Building occupants report that this office requires repeated cleaning with bleach because of mold growth. Cooking may produce large amounts of water vapor in the form of steam. If allowed to accumulate in an area without ventilation, building materials such as wall plaster and paint may serve a mold growth media. To prevent this, local exhaust ventilation should be used to exhaust water vapor from the office.

Other Concerns

A number of areas throughout the building demonstrated conditions that can result in the aerosolization of irritating materials into the school environment. Since the Putnam Vocational Center contains numerous Vocational Education Programs (VEPs), this section of the report will be divided into sections either by the shop activity or by the noted issues. In addition to repairing the ventilation system, the identification, proper storage of or elimination of these materials would serve to enhance improved indoor air quality in the building.

Machine Shop/Horticulture (H Wing)

The basement of H wing contains both the machine shop and the horticulture programs. Originally the machine shop occupied the entire basement floor. A number of metal fume/dust-producing pieces of equipment are connected to a dust collector. The metal dust collector is located on the east side of this area. As this equipment operates, dust and fumes are captured by the air stream an introduced into the collector. Heavy dust is removed from the air stream, with the exhaust air exiting the collector through a vent that is usually connected by ductwork to an outdoor exhaust vent. The collector air stream exhaust vent could not be located on this equipment. Therefore, it appears that the dust collector is not ducted outdoors. Supplementary local exhaust fans were noted in the west wall of this area. These fans are designed to remove fine aerosolized metal fume/dust, heat and other pollutants. It appears that the fans are non-functional, since the outdoor housing was heavily vandalized and/or contained bird's nests (see Picture 18). In this existing configuration, both fine metal dust and collector exhaust air would be drawn across the metal working machinery, leading to exposure opportunities for student operators.

The machine equipment consists of metal lathes, surface grinding wheels and metal drills. As each of these machines grind or cut metal, heated metal particles (called fume) is produced and aerosolized. Metal fumes are respiratory irritants. Both the Occupational Safety and Health Administration (OSHA) and the American Conference of Governmental Industrial Hygienists (ACGIH) have established Permissible Exposure Limits (PELs) (OSHA, 1997) and Threshold Limit Values (TLVs) (ACGIH, 1999) for various metal fumes. An evaluation of the contents of the material-producing fume must be done in order to ascertain which PEL or TLV applies in this situation. This evaluation, as well as an evaluation of the concentration of materials being aerosolized, should be done by a certified industrial hygienist. Please note that these exposure standards apply to healthy adult employees in the workforce. Students who are in this environment are not considered employees for the purposes of OSHA regulations or ACGIH TLVs. In this case, levels of airborne fumes should be reduced to minimally feasible levels in order to prevent student exposure to metal fumes. The ACGIH has recommended standards for local exhaust ventilation for specific operations such as surface grinders, grinding wheels, lathes, and metal band saws (ACGIH, 1998). If this is not practicable, individual personal protective equipment that is fit-tested for each individual should be considered.

The school acquired the framework for an outdoor greenhouse for the horticulture program. As reported by school officials, this structure was erected inside the metal shop area (see Picture 19), since the school could not obtain permits from the Springfield Building Department. The greenhouse has a single exhaust vent fan located in its north wall to exhaust air and excess moisture. The south wall of the greenhouse has a passive vent that would allow outdoor air to enter the greenhouse. This configuration of the greenhouse in the metal shop poses several problems.

1. The operation of the greenhouse exhaust vent fan will eject excess moisture into the metal shop *indoors*. Uncontrolled introduction of moisture into the indoor environment can lead to moistening of porous materials (e.g., carpeting, gypsum wallboard, etc.) which can lead to subsequent microbial growth.
2. Horticulture can result in mold growth in soil and other associated materials. The lifecycle of mold includes the formation of spores, many of which can readily become airborne. With the greenhouse exhaust vent operating, spores can enter the exhaust air stream and be vented into the metal shop area.
3. Horticulture can require the use of malodorous materials (e.g. fertilizer). The operation of the greenhouse exhaust fan can result in the introduction of these odors into the metal shop.
4. The position of the greenhouse would effectively block the existing exhaust vents in the west wall (see Figure 2) This condition can result in fine metal dust accumulating in the metal shop area.
5. If the exhaust vent for the greenhouse and the metal dust collector are operating, fine metal dust can be drawn into the greenhouse through the passive vent. This can result in increased metal dust exposure to students inside the greenhouse.

The placement of the greenhouse in the metal shop may produce each of these denoted problems. Further modification to the ventilation system in this area may be necessary to prevent pollutants from each program from impacting each other.

Graphics Department (H Wing)

The graphic art department contains a print shop, photography classrooms, and darkrooms. During the first day of evaluation of this building, odors of organic solvents were detected upon entering the print shop area. An exhaust hood exists in the corner of this area. All efforts to activate this vent failed. Inside the print shop area a number of printers that use volatile organic compounds (VOCs) were noted. No local dedicated exhaust ventilation exists for any of the printers. It appears that the room was designed to have the broken exhaust hood draw evaporating VOCs across the room. The concentrations of total volatile compounds (TVOCs) measured ranged from 0.6 ppm to 198 ppm (see Table 22), dependent of the material sampled. TVOCs are the sum concentration of various evaporating VOCs. Inks containing VOCs are used in this classroom. As previously mentioned, VOCs can be irritating to the eyes, nose, throat and respiratory system. Products containing VOCs must be used with adequate exhaust ventilation to prevent exposure. The photography area in the graphics department is equipped with carpeting. In addition to serving as a medium for mold growth, moistened carpeting may also serve as a reservoir for off-gassing chemicals if contaminated by photography chemicals. The carpet may absorb spilled chemicals. Once contaminated, the carpeting can serve as a "sink" which slowly off-gasses chemicals over time. Non-porous floors are generally recommended in areas with heavy water or chemical use to prevent mold growth and/or chemical contamination.

HVAC (H Wing)

The HVAC shop formerly housed the welding shop, which contains fifteen welding stations connected to a dedicated local exhaust vent system. Shop occupants report local exhaust vent was observed with smoke escaping from a welding booth, despite the presence of a local exhaust ventilation system. Black soot covering the upper surfaces of insulation of pipes along the ceiling is a sign of settling soot, which would confirm occupant observations. This escape of smoke from the welding booth is attributed to the lack of velocity of exhaust ventilation drawn from the elephant trunk vents connected to the exhaust ductwork and fan (see Pictures 20). Air drawn into the welding exhaust vent must make an estimated 450^o in curves before reaching the exhaust vent fan above the ceiling. As a general rule, each 90^o bend in ducting will reduce the draw of air by 50 percent. In this case, an exhaust hose makes roughly five 90^o turns (450^o). Assuming that the velocity of the draw of air at the metal ductwork at the top of the flexible hose equals 100 percent, the draw of air at the base of the vent is reduced to roughly 3 percent of the draw because of the five 90^o bends in the hose of each welding station. In addition, since there are 15 workstations, the draw of air would be reduced on average to 0.2 percent (3/15). To increase the draw of air and welding pollutants, it is recommended that the exhaust vents for 8 of the welding stations be capped to increase the draw of air by the welding exhaust system. Mechanical metal grinding is conducted in this area. It is reportedly proposed to convert one of the welding workstations to provide local exhaust ventilation for metal grinding.

The ceiling of this area is equipped with a series of "Smoke Eaters®", a mechanical air filtration system. Presumably, these units were installed to trap excess smoke particles not captured by the welding exhaust vent system. Each of these units is equipped with filters, which require regular changing. If these filters become saturated, each unit will cease to remove particles and serve as a potential source to spread pollutants. It is recommended that the better practice to remove welding particulate is to improve the welding exhaust ventilation and abandon the use of the ceiling-mounted air filters.

Auto Mechanics (H Wing)

The automobile repair shop has waste material stored against the north wall of the garage. In order to remove odors associated with these automotive wastes, it is recommended that a mechanical local exhaust fan be installed over the stored materials. An unvented grinding machine is located in a caged area in the northwest corner of the garage. Also located within this caged area is a return vent for the garage AHU. When the grinding machine is used, aerosolized metal fumes can be entrained by the HVAC system and distributed to other sections of the garage.

Carpentry (H Wing)

At the request of PVTHS staff, decibel (dBA) levels were measured in various areas of the carpentry shop (see Table 23). The noise levels measured ranged from 74 dBA on the carpentry shop balcony to 108 dBA at the rear of the wood planer (during operation of this machine). Faculty and students did not appear to use hearing protection equipment while operating machinery in the wood shop. Exposure to excessive noise may result in hearing impairment. In addition, noise can also result in increased stress, fatigue, loss of concentration and interfere with sleep (OSHA, 1995a). Both the

Occupational Safety and Health Administration (OSHA) and the American Conference of Governmental Industrial Hygienists (ACGIH) have established Permissible Exposure Limits (PELs) (OSHA, 1997) and Threshold Limit Values (TLVs) (ACGIH, 1999) for noise levels. The PEL for noise in an 8-hour workday, time-weighted average is 90 dB. The TLV for noise is dependent on both the noise level measured and the amount of time exposed to that noise level. The TLV for noise in an 8-hour workday, time-weighted average is 85 dB. Table 24 lists the recommended time duration for exposure to the measured decibel levels above the noise TLV over 85 dB.

An evaluation the noise levels throughout the carpentry shop is necessary in order to characterize noise levels throughout the entire school day. This evaluation must be done in order to ascertain which PEL or TLV applies in this situation. In addition, this evaluation should be done by a certified industrial hygienist. Please note that these exposure standards apply to healthy adult employees in the workforce. Students who are in this environment are not considered employees for the purposes of OSHA regulations or ACGIH TLVs. In this case, noise levels should be reduced to minimally feasible levels or hearing protection equipment should be used to prevent student exposure to noise. To aid in this activity a hearing conservation program to prevent hearing injury should be created. A hearing conservation program would consists of noise monitoring, individual hearing testing and fitting for hearing protective equipment (OSHA, 1995b). A copy of the OSHA hearing conservation program is attached as Appendix A.

Several local exhaust vents for wood dust generating machinery were found clogged, rendering the dust collection ineffective. Wood dust can be an irritant to the eyes, nose and throat and should be properly vented.

Cosmetology (C-wing)

The cosmetology department is located in the basement and serves as a connecting path between the culinary arts program and the remainder of the building complex (see Picture 21). Ventilation is provided by four univents located along the exterior wall. Exhaust ventilation appears to be ceiling mounted vents located in the center of the room. In order to provide privacy for cosmetology students during class, five foot tall floor dividers are used to form a corridor through the center of the cosmetology area (see Figure 3) for occupants to travel to and from the culinary arts department. This floor divider configuration separates/minimizes the draw/removal of cosmetology odors from this area. The practice of cosmetology frequently requires the use of ethanol containing materials for sterilization of equipment purposes as well as methyl methacrylate, which is in nail preparation products. Each of these producs contains VOCs. No local dedicated exhaust ventilation exists in this area. The concentrations of total volatile compounds (TVOCs) measured ranged from 0.4 ppm to 248 ppm within the cosmetology area (see Table 25), dependent of the material sampled. (please note that the highest readings were taken 2 inches over an open container of product). TVOCs are the sum concentration of various evaporating VOCs. Products containing VOCs must be used with adequate exhaust ventilation to prevent exposure. During the assessment both the supply and exhaust ventilation systems were deactivated and a strong odor of nail polish was noted. Without dilution and removal via the mechanical ventilation system, these materials can build up resulting in eye and respiratory irritation to sensitive individuals.

General Environmental Pollutants

Bird Nesting

Bird wastes observed inside the auditorium were denoted in a previous letter (MDPH, 2000), which is included with this report as Appendix A. Birds' nests were also seen in various areas of the perimeter of the building. Bird feathers/wastes were noted on the terrace directly outside of classroom A-212 in close proximity to the univent fresh air intake. The Graphics area appears to have a bird's nest inside the roll-up garage door housing (see Picture 22). Nesting materials was seen protruding from the door housing and were found on the graphics room floor. As noted previously, univents in A-wing were not equipped with filters. Under these conditions it is possible for molds and allergenic materials associated with bird wastes and feathers to be entrained by the air intake and distributed into the classroom via the univent. Bird wastes in a building raise three concerns: 1) diseases that may be caused by exposure to bird wastes, 2) the need for clean up of bird waste and 3) appropriate disinfection.

Certain molds are associated with bird waste and are of concern for immune compromised individuals. Other diseases of the respiratory tract may also result from chronic exposure to bird waste. Exposure to bird wastes are thought to be associated with the development of hypersensitivity pneumonitis in some individuals. Psittacosis (bird fancier's disease) is another condition closely associated with exposure to bird wastes in either the occupational or bird raising setting. While immune compromised individuals have an increased risk of health impacts following exposure to the materials in bird waste, these impacts may also occur in healthy individuals exposed to these materials.

The methods to be employed in clean up of a bird waste problem depend on the amount of waste and the types of materials contaminated. The MDPH has been involved in several indoor air investigations where bird waste has accumulated within ventilation ductwork (MDPH, 1999). Accumulation of bird wastes have required the clean up of such buildings by a professional cleaning contractor. In less severe cases, the cleaning of the contaminated material with a solution of sodium hypochlorite has been an effective disinfectant (CDC, 1998). Disinfection of non-porous materials can be readily accomplished with this material. Porous materials contaminated with bird waste should be examined by a professional restoration contractor to determine if the material is salvageable. Where a porous material has been colonized with mold, it is recommended that the material be discarded (ACGIH, 1989).

The protection of both the cleaner and other occupants present in the building must be considered as part of the overall remedial plan. Where cleaning solutions are to be used, the “cleaner” is required to be trained in the use of personal protective methods and equipment (to prevent either the spread of disease from the bird wastes and/or exposure to cleaning chemicals). In addition, the method used to clean up bird waste may result in the aerosolization of particulates that can spread to occupied areas via openings (doors, etc.) or by the ventilation system. Methods to both prevent the spread of bird waste particulates to occupied areas or into ventilation ducts must be employed. In these instances, the result can be similar to the spread of renovation-generated dusts and odors in occupied areas. To prevent this the cleaner should employ the methods listed in the SMACNA Guidelines for Containment of Renovation in Occupied Buildings (SMACNA, 1993).

Rodent Infestation

The building also shows signs of rodent infestation. It was reported to BEHA staff that mice had been seen in the building and mouse wastes were found in refrigerator drip pans. Rodents were also reported to have eaten the bindings of textbooks (see Picture 23). An examination of the exterior of the building identified several rodent harborages. Yard waste (see Picture 24), dirt piles (see Picture 25) and other collections of debris can provide adequate shelter to support rodent populations. To penetrate the exterior of a buildings, rodents require a minimal breach of ¼ inch (MDFA, 1996). Spaces beneath doors and holes in wood panels (see Picture 26) were noted around the exterior of the building, each of which would be sufficient to allow rodents to enter the building. Rodent infestation results from easy access to food and water in a building. Evidence of food sources includes candy wrappers in univents and food on radiators in the cafeteria (see Picture 27). Rodent infestation can result in indoor air quality related symptoms due to materials in their wastes. Mouse urine contains a protein that is a known sensitizer (US EPA, 1992). A three-step approach is necessary to eliminate rodent infestation:

1. removal of the rodents;
2. cleaning of waste products from the interior of the building; and
3. reduction/elimination of pathways/food sources that are attracting rodents.

To eliminate exposure to allergens, rodents must be removed from the building. Please note that removal, even after cleaning, may not provide immediate relief since allergens can exist in the interior for several months after rodents are eliminated (Burge, 1995). A combination of cleaning, increase in ventilation and filtration should serve to reduce rodent associated allergens once the infestation is eliminated. Under current Massachusetts law that will go into effect November 1, 2001, the principles of integrated pest management (IPM) must be used to remove pests in schools (Mass Act, 2000).

Blockage of Univent Fresh Air Intakes

Along the perimeter of the building (and interior courtyard), univent fresh air intakes were noted close to ground level (see Picture 28). Care should be taken to ensure that fresh air intakes remain clear of obstructions (e.g., snow, shrubbery, etc.) to avoid the entrainment of dirt, moisture, pollen and/or other particulate matter.

Science Wing Chemical Storage

Chemicals were stored in a storeroom on the second floor science area of E-wing. Of note was the condition of a jar of sodium metal found stored on an open shelf in this area. Sodium metal is water reactive (NFPA, 1991) and is an extreme fire hazard. This material must be stored in a non-water liquid to prevent moist air from contacting the surface of this material. The liquid in the jar appeared to have evaporated exposing the upper surface of the material (see Picture 29). The conditions of the container can lead to the eventual drying of the storage liquid and exposure of sodium to the air, which is unacceptable for this material. It is highly recommended that a thorough inventory of chemicals in the science department be done to assess chemical storage and disposal in an appropriate manner consistent with Massachusetts hazardous waste laws.

Asbestos

Concerns were raised by building occupants about the presence of asbestos in floor tiles in computer room A-304. Holes were bored in flooring to allow for wiring of equipment (see Picture 30). Possible asbestos containing floor tiles were also noted above the print shop/graphics area broken, damaged and crumbling (see Picture 31).

Intact asbestos-containing materials do not pose a health hazard. If damaged, asbestos-containing materials can be rendered friable and become aerosolized. Friable asbestos is a chronic (long-term) health hazard, but will not produce acute (short-term) health effects (e.g., respiratory symptoms, headaches, etc.) typically associated with buildings that are believed to have indoor air quality problems. Where asbestos-containing materials are found damaged, these materials should be removed in a manner consistent with Massachusetts asbestos remediation laws (MDLI, 1993). To determine if these floor tiles contain asbestos, a review of the building's blueprints, purchase orders or contacting the manufacturer is recommended.

Lead

The basement of the A-wing contains an area that was formally used as a rifle range by various City of Springfield agencies. This rifle range is now used as storage and does not appear to be accessible to students. Lead exposure to women who have the potential of being pregnant poses a number of risks to the developing fetus (ATSDR, 1999). Lead exposure, particularly in the early stages of pregnancy when the woman may not know that they are pregnant, may result in adverse effects from *in utero* exposure to lead. Lead exposure in males has been associated with reduced fertility because of effects on sperm (ATSDR, 1999). It is highly recommended that students and pregnant employees not have access to the rifle range area of the building. All individuals who have access to this area should increase hand and face washing in order to reduce exposure from residual lead that may contaminate flat surfaces in this classroom.

Vehicle Exhaust Penetration

Although no complaints of vehicle exhaust odors have been reported within the building, the potential for entrainment exists. Picture 32 illustrates the close proximity of the parking lot to the building and the potential for vehicle exhaust to be pulled into the univent fresh air intakes (called entrainment). Idling vehicles can result in the entrainment of vehicle exhaust into the building, which may, in turn, provide opportunities for exposure to compounds such as carbon monoxide. M.G.L. chapter 90 section 16A prohibits the unnecessary operation of the engine of a motor vehicle for a foreseeable time in excess of five minutes (MGL, 1996).

Univent Condition/Filters

Univents are normally equipped with filters that strain particulates from airflow. The filters provide minimal filtration of respirable dusts. In order to decrease aerosolized particulates, disposable filters with an increased dust spot efficiency can be installed in univents. The dust spot efficiency is the ability of a filter to remove particulates of a certain diameter from air passing through the filter. Filters that have been determined by ASHRAE to meet its standard for a dust spot efficiency of a minimum of 40 percent (Minimum Efficiency Reporting Value equal to 9) would be sufficient to reduce many airborne particulates (Thornburg, D., 2000; MEHRC, 1997; ASHRAE, 1992). Note that increasing filtration can reduce airflow (called pressure drop) which can reduce the efficiency of the univent due to increased resistance. Prior to any increase of filtration, each univent should be evaluated by a ventilation engineer to ascertain whether it can maintain function with more efficient filters.

It is also important that air filters for air handling equipment fit flush in their racks. The interior of the AHU for the gymnasium was examined, several filters were noted missing or crushed within the unit (see Picture 33). In order to provide air filtration as designed, a complete set of tight fitting air filters should be installed and routinely replaced. Unfiltered air passing through this system can introduce mold, spores and nutrients into this air handler. With the addition of moisture, mold growth can occur, leading to mold being distributed by the ventilation system. Fitting of filters into their racks to prevent spaces that allow for unfiltered air to be introduced into air handlers is necessary to reduce particulates, including mold, into the HVAC system.

A number of univents had accumulated dirt, dust and debris within sections of the system in contact with airflow. In order to avoid univents serving as a source of aerosolized particulates, the air handling sections of the univents should be regularly cleaned and have filters changed on a regular schedule. As mentioned previously, univents in A-wing did not have filters, which can allow for dirt, dust and debris to easily penetrate the interior of the building.

Miscellaneous Areas

Many areas contain photocopiers; the drafting room (C-302) contains a blueprint machine. Blueprint machines use ammonia and can give off gas and irritating odors during use. VOCs and ozone can be produced by photocopiers, particularly if the equipment is older and in frequent use. Ozone is a respiratory irritant (Schmidt Etkin, D., 1992). Photocopiers and computer equipment also give off excess heat. Mechanical exhaust ventilation should be activated in these areas. Without mechanical exhaust ventilation, excess heat, odors and pollutants produced by office equipment can build up.

The art rooms have containers of flammable materials stacked inside the flameproof cabinet or have flammable materials stored in cabinets that are not flameproof. One classroom had open cans of latex paint. While latex paint is water-based, these products contain VOCs that can evaporate and be a source of respiratory irritation.

A loosely capped bucket of pig uteri was noted under the chemical hood in C-305. The mediation office contained a time-released air freshener. Air fresheners and preservatives associated with animal specimens contain chemicals that can be irritating to sensitive individuals. In addition, air fresheners do not remove materials causing odors, but rather mask odors which may be present in the area.

Accumulated chalk dust was noted in many classrooms (see Picture 34). Chalk dust is a fine particulate, which can be easily aerosolized and serve as an eye and respiratory irritant. Several classrooms contained dry erase boards and markers. Materials such as dry erase markers and cleaners may contain VOCs, (e.g., methyl isobutyl ketone, n-butyl acetate and butyl-cellusolve) (Sanford, 1999). Exposed fiberglass pipe insulation was noted in several classrooms, restrooms and hallways throughout the school. Airborne fiberglass particles can serve as a skin and respiratory irritants to sensitive individuals.

As mentioned previously, mechanical exhaust ventilation in some restrooms was not functioning during the assessment. Exhaust ventilation is necessary in restrooms to remove moisture and to prevent restroom odors from penetrating into adjacent areas.

Missing/damaged ceiling tiles and open utility holes were noted in a number of areas throughout the school. Holes in ceilings and walls are breaches that can serve as a source and means of egress for odors, fumes, dusts and vapors between rooms and floors.

Also of note was the amount of materials stored inside classrooms. In classrooms throughout the school, items were seen piled on windowsills, tabletops, counters, bookcases and desks. The large amounts of items stored in classrooms provide a source for dusts to accumulate. These items, (e.g. papers, folders, boxes, etc.) make it difficult for custodial staff to clean around these areas. These items should be relocated and/or should be cleaned periodically to avoid excessive dust build up. Household dust can be irritating to the eyes, nose and respiratory tract.

Many shops and ground floor areas are equipped with floor drains. Areas such as the cafeteria, locker rooms, carpentry wood storeroom and other areas have drains that did not appear to have recently drained water, which can lead to dry traps. A trap forms an airtight seal when water is poured down the drain. A dry trap can allow for sewer gas to back up into the building. Sewer gas can be irritating to the eyes, nose and throat. In addition, a number of disabled water fountains were found sealed with cardboard (see Picture 35). As with floor drains, water fountains also have drain traps that can dry out and be a source of sewer odors.

Stored materials around the exterior of the building were found to have mosquito eggs floating in accumulated standing water (see Picture 36). Standing water can serve as a breeding ground for mosquitoes and should be removed were found.

Conclusions/Recommendations

The conditions noted at the Putnam Vocational School raise a number of complex issues. The combination of the design of the building, maintenance, work hygiene practices and the condition of stored materials in the building, present conditions that can adversely influence indoor air quality in the building. For these reasons a two-phase approach is required, consisting of **(short-term)** immediate measures to improve air quality and **long-term** measures that will require planning and resources to adequately address overall indoor air quality concerns. In view of the findings at the time of the visits, the following **short-term** recommendations are made:

1. Implement the corrective actions recommended concerning remediation of bird wastes (see Appendix B) (MDPH, 2000).
2. Consider developing a written notification system for building occupants to report construction/renovation related odors and/or dusts problems to the building administrator. Have these concerns relayed to the maintenance/public building management in a manner to allow for a timely remediation of the problem.
3. To maximize air exchange, the BEHA recommends that both supply and exhaust ventilation operate continuously during periods of school occupancy independent of classroom thermostat control.
4. Examine each univent for function. Survey classrooms for univent function to ascertain if an adequate air supply exists for each room. Consider consulting a heating, ventilation and air conditioning (HVAC) engineer concerning the calibration of univent fresh air control dampers school-wide.
5. Since the univent in the nursing office nearest the elevator is redundant, consider sealing the fresh air supply vent on the roof to prevent cold air backdrafting. In addition, close the dampers of the univent in this office.
6. Repair restroom exhaust ventilation.
7. Repair the exhaust vent in the kitchen office.
8. Thermostat settings throughout the complex should be evaluated. Thermostats should be set at temperatures to maintain comfort for building occupants.

9. Inspect rooftop exhaust motors and belts for proper function, repair and replace as necessary.
10. Remove all blockages from univents and exhaust vents to facilitate airflow.
11. Once both the fresh air supply and exhaust ventilation are functioning, the systems should be balanced by a ventilation engineer.
12. Discontinue the use of Smokeaters® in HVAC shop.
13. Remove leaves, trash and other accumulated wastes from school roofs.
14. Clean all low-lying roofs drain catches of debris to enhance rainwater drainage. Replace all missing drain catches to prevent drain clogs. Examine each roof drain for clogs and remove where found. Consider instituting a low lying roof inspection on a weekly basis to examine catch basins for blockage.
15. Consider instituting a hearing conservation program for all industrial shops. This program would include hearing examines for all users of the shops, noise attenuation measures and the use of personal protective equipment by shop users.
16. Continue with plans to alter the welding exhaust ventilation system in the HVAC shop to improve exhaust of welding-generated pollutants and grinding fumes.
17. Consider installing an exhaust fan over waste storage barrels in autoshop to exhaust odors.
18. Consider moving grinding equipment away from the return exhaust vent. Examine the feasibility of installing local exhaust ventilating equipment for all grinding equipment.
19. Remove bird nest from rolling door in graphic arts area. Consider installing anti-bird landing devices on outdoor flat exterior surfaces to discourage bird nesting.

20. Remove all vegetation from the exterior wall/tarmac seam. Reseal tarmac cracks. Seal the exterior wall/tarmac junction with a water impermeable sealant.

21. Remove bird's nests from the exhaust vents of the metal/horticultural shop. Repairs these exhaust fans to working order. Examine the feasibility of installing fans in a configuration to reduce vandalism of this equipment.

22. Repair the exhaust vent hood in the graphic department. Examine the feasibility of extending a duct from this hood to provide local exhaust vents for each printing press.

23. Reconfigure the floor dividers in the cosmetology program to enhance airflow and exhaust ventilation of barbering and nail application areas (see Figure 4).

24. Evaluate the photography area in the graphics department for water and/or photography chemicals usage. In those areas using water/photography chemicals, consider replacing carpeting with a non-porous, non-slippery floor covering.

25. Remove accumulated yard waste and dirt piles along the exterior of the building to eliminate rodent harborages. Examine exterior wall for holes and reseal to prevent rodent access to the interior of the building. Examine all exterior door for spaces large enough to admit rodents. If found, consider sealing the bottom of each door with a barrier (e.g. weather stripping) to eliminate egress.

26. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, implementation of scrupulous cleaning practices should be implemented. This will minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. Use of vacuum cleaning equipment outfitted with a high efficiency particulate arrestance filter (HEPA) is recommended. Drinking water during the

day can help ease some symptoms associated with a dry environment (throat and sinus irritations).

27. Replace any remaining water-stained ceiling tiles. Examine the area above and around these areas for mold growth. Disinfect areas of water leaks with an appropriate antimicrobial.

28. Seal window frames and repair broken windows to prevent water penetration.

29. Move plants away from univents in classrooms. Examine drip pans for mold growth and disinfect areas of water leaks with an appropriate antimicrobial where necessary. Consider discontinuing the use of window planters inside the building. Examine windowsills beneath window planters for water damage and microbial growth. If wooden windowsills are colonized with mold growth, replacement of windowsill should be considered.

30. Examine basement storage area for proper drainage and make repairs as needed, examine periodically for standing water.

31. Examine water-stained carpeting in the main office for mold growth. If moldy discard carpet. Disinfect areas beneath and around carpeting with an appropriate antimicrobial.

32. Have a chemical inventory done in all storage areas and classrooms. Properly store flammable materials in a manner consistent with the local fire code. Discard hazardous materials or empty containers of hazardous materials in a manner consistent with environmental statutes and regulations. Label chemical containers with the chemical name of its contents. Follow proper procedures for storing and securing hazardous materials.

33. Obtain Material Safety Data Sheets (MSDS) for chemicals from manufacturers or suppliers. Maintain these MSDS' and train individuals in the proper use, storage and protective measures for each material in a manner consistent with the Massachusetts Right-To-Know Law, M.G.L. c. 111F (MGL, 1983).

34. Examine asbestos floor tiles for damage. If asbestos is in a friable state, remove the damaged material in a manner consistent with Massachusetts asbestos remediation and hazardous waste disposal laws.

35. Replace missing ceiling tiles and fill utility holes and wall cracks to prevent the egress of dirt, dust and particulate matter between rooms and floors. Particular attention should be paid to sealing utility holes on the first floor to prevent potential crawlspace odors from entering occupied areas.

36. Repair water fountains. If not feasible, seal permanently unused water fountain drains and disconnect water supply.

37. Flat surfaces in the shops should be cleaned of accumulated dust to prevent reaerosolization.

38. Examine exterior drains in doorway and unclog if necessary.

39. Refrain from using strong scented materials in offices and restrooms.

40. Relocate or consider reducing the amount of materials stored in offices to allow for more thorough cleaning. Clean items regularly with a wet cloth or sponge to prevent excessive dust build-up.

41. Change filters for air-handling equipment as per the manufacture's instructions or more frequently if needed. Vacuum interior of univents prior to activation to prevent the aerosolization of dirt, dust and particulates. Ensure filters fit flush in their racks with no spaces in between allowing bypass of unfiltered air into the

unit. Obtain air filter brackets to prevent air-bypass if multiple filters are installed in one rack.

42. Examine the feasibility of installing more efficient filters in HVAC equipment.

43. Clean chalkboards and chalk trays regularly to prevent the build-up of excessive chalk dust.

44. It is highly recommended that the principles of integrated pest management (IPM) be used to rid this building of pest. A copy of the IPM recommendations are included with this report as Appendix C (MDFA, 1996).

45. Ensure used paint and animal specimen containers are properly secured.

46. Repair damaged fiberglass insulation.

47. Pour water into floor drains throughout the complex biweekly to maintain the airtight seal of traps.

48. Empty standing water from accumulated materials on the exterior of the school.

The following **long-term** measures should be considered. *A ventilation engineer should be consulted to resolve air supply/exhaust ventilation building-wide. With regard to* ***each industrial shop program****, it is highly recommended that a certified industrial hygienist be consulted to evaluate the industrial hygiene practices and procedures in all shop areas and appropriate ventilation practices for the science area chemical storage rooms. The following areas should be addressed:*

1. Have an experienced hazardous waste removal consultant evaluate the chemical preparation room 211-A for proper chemical storage and recommendations for removal of hazardous waste.

2. Provide local exhaust ventilation consistent with recommendations of the American Conference of Governmental Industrial Hygienists (ACGIH) for all metal fume-producing procedures. (ACGIH, 1998). The construction of local exhaust ventilation for the machinery in the machine shop and printers in the graphics area are all highly recommended for shop activities to continue.
3. Consider installing a local mechanical exhaust fan for the blueprint machine to remove excess heat and odors.
4. Examine the feasibility of providing exhaust ventilation to classrooms without exhaust ventilation. Particular attention should be given to interior classrooms without openable windows.
5. Examine the feasibility of enhancing drainage from low-lying roofs to reduce water pooling. This may include redirecting the pitch of the roof towards drains or installation of new drains.
6. Repair and/or replace thermostats and pneumatic controls as necessary to maintain control of thermal comfort. Consider contacting an HVAC engineer concerning the repair and calibration of thermostats and pneumatic controls school-wide.
7. Consider having exterior brick repointed to prevent further moisture penetration and subsequent water damage.
8. Restrict access to the rifle range in a manner described earlier in this report. If this area is proposed for use, it is highly recommended that this area be evaluated for lead contamination.
9. Examine the feasibility of ducting the exhaust fan for the greenhouse directly outdoors.

10. Examine the feasibility of providing a fresh air supply for the greenhouse to prevent metal shop pollutants from entering the greenhouse.

11. Examine the feasibility of moving the metal shop dust collector to a location where a duct can be connected to an exterior wall to direct collector air directly outdoors.

12. Obtain blueprints (if available) of the original building to determine the configuration of the exhaust ventilation in A-wing. Once the configuration is identified, consider consulting a ventilation engineer concerning the best method to reactivate exhaust ventilation in A-wing. If this is done, please note that the basement of A-wing may be connected to this exhaust system. Measures should be taken to prevent A-wing basement pollutants (e.g., possible lead) from being entrained into this reactivated system. This measure should include sealing of vents as well as all wall cracks and utility holes that exist in basement walls and ceilings.

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Figure 2 **Greenhouse Blocking Exhaust Vent Airflow**

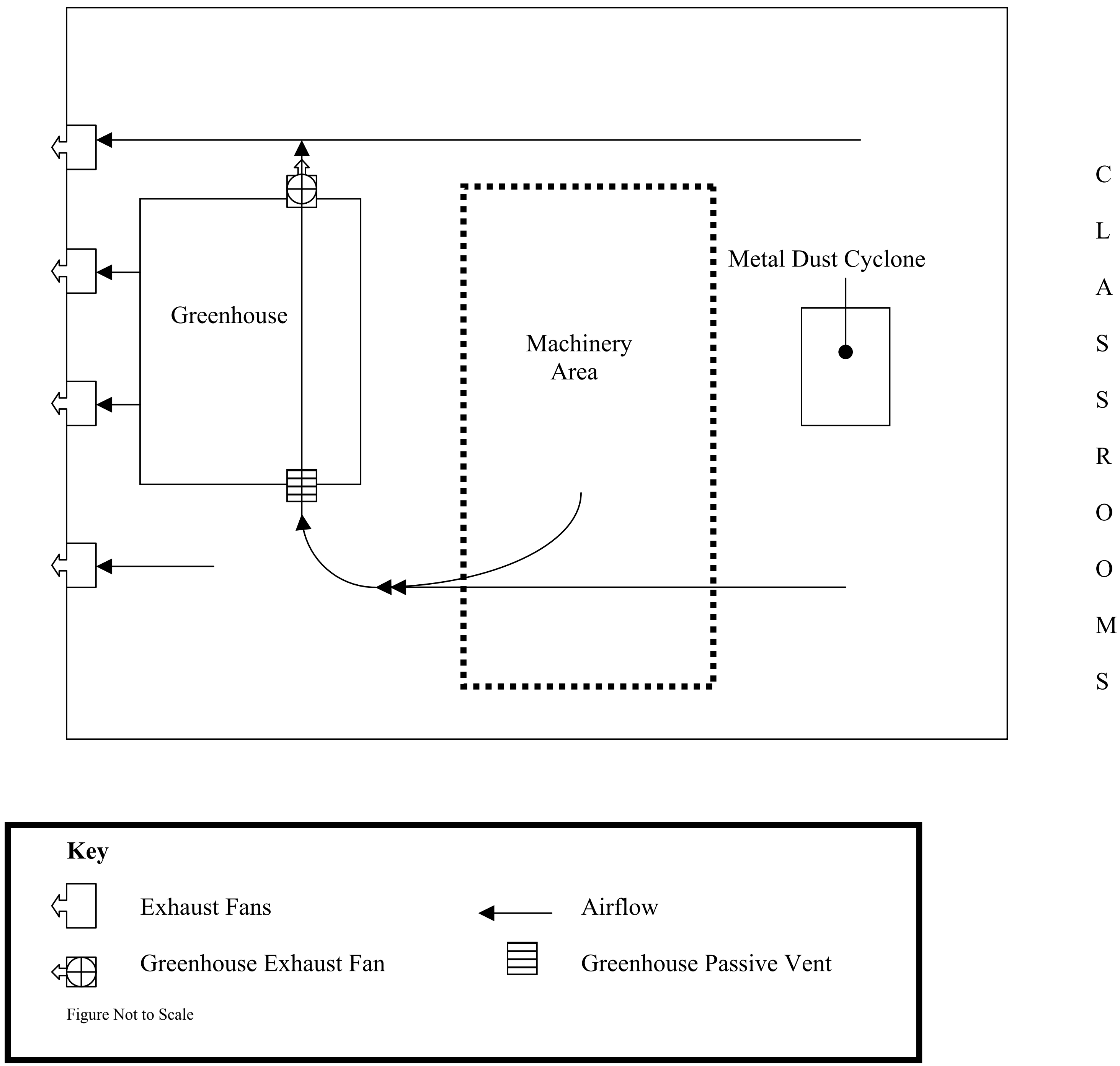


Figure 3 **General Configuration of Cosmetology Department**

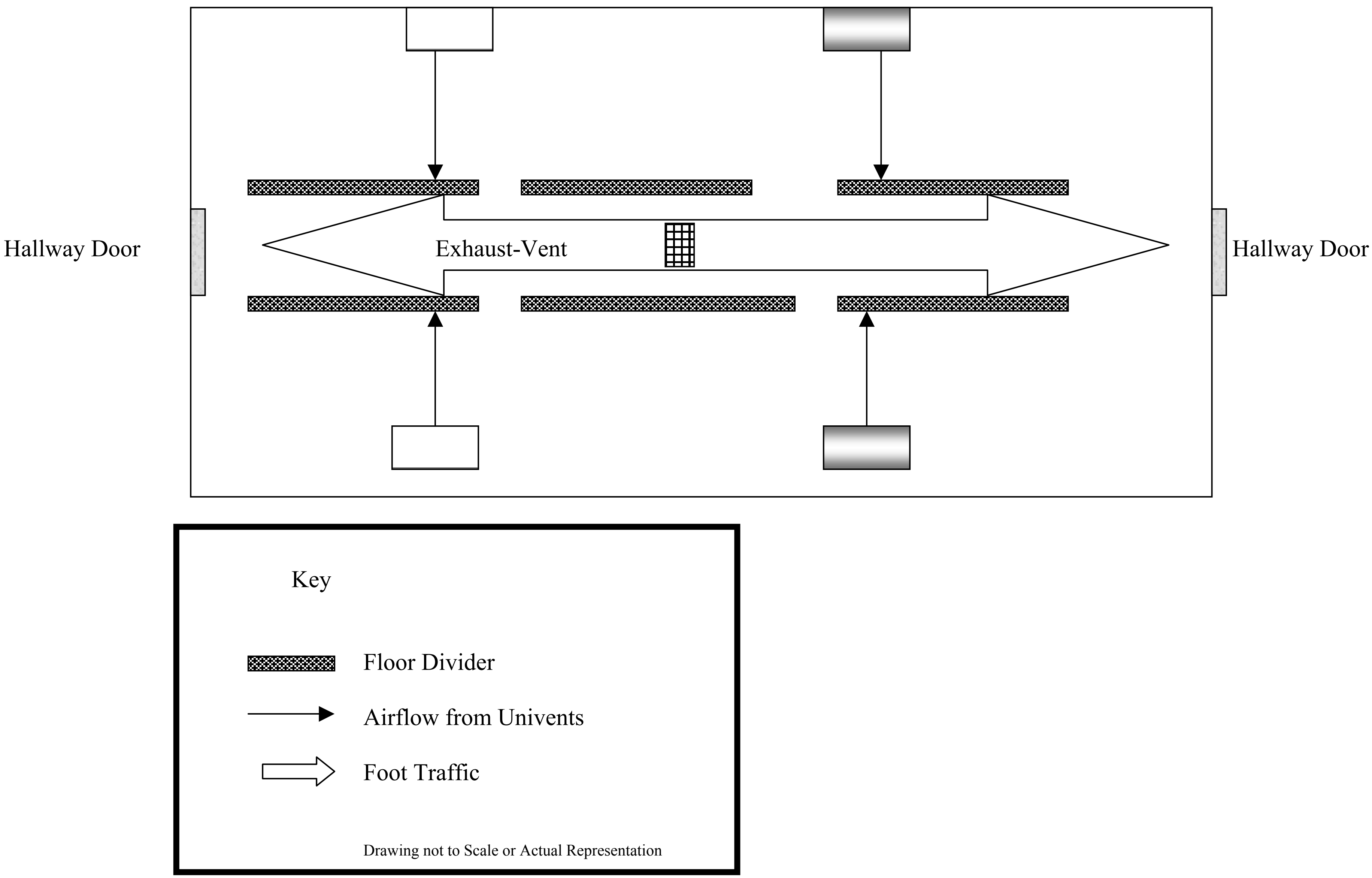
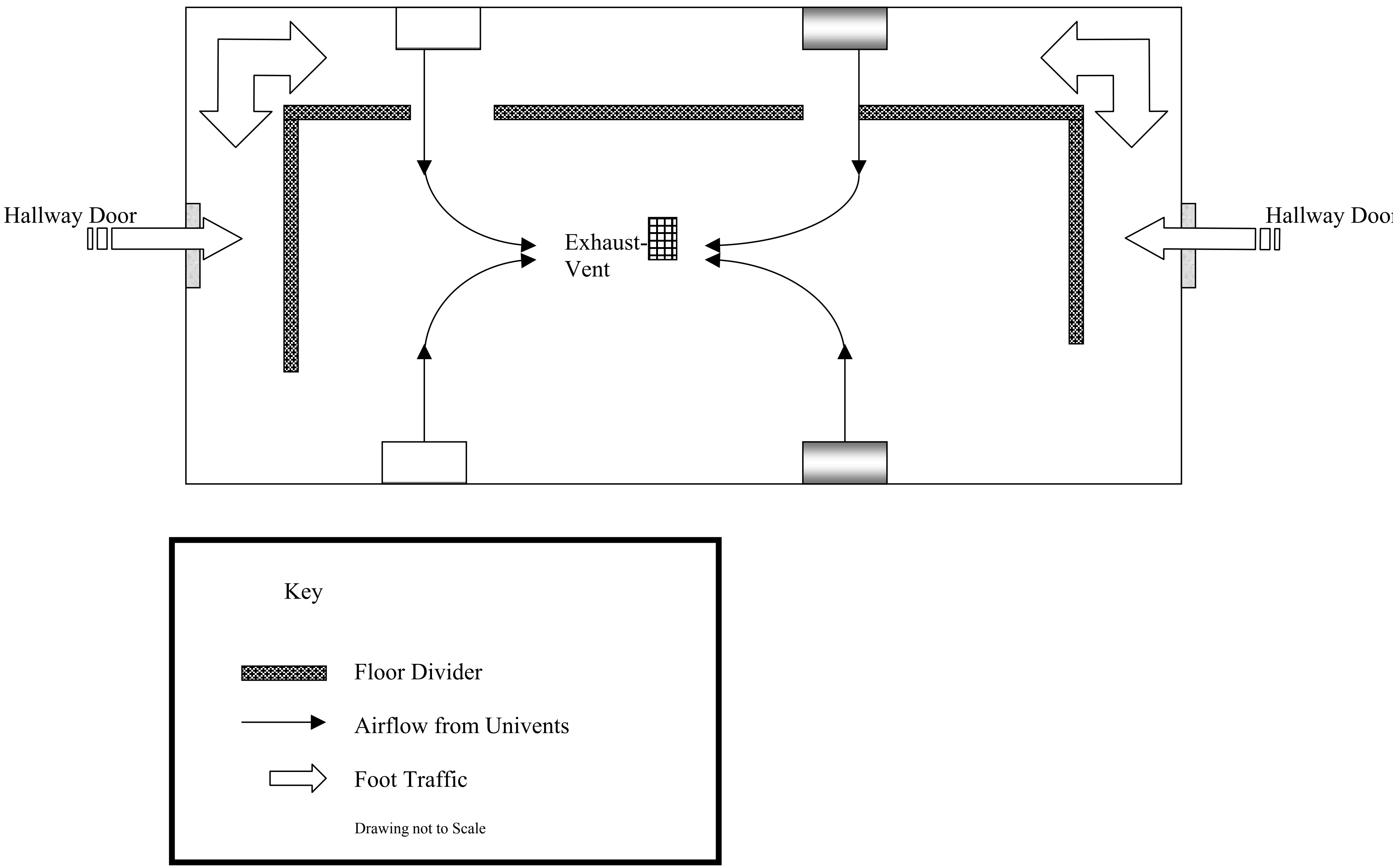


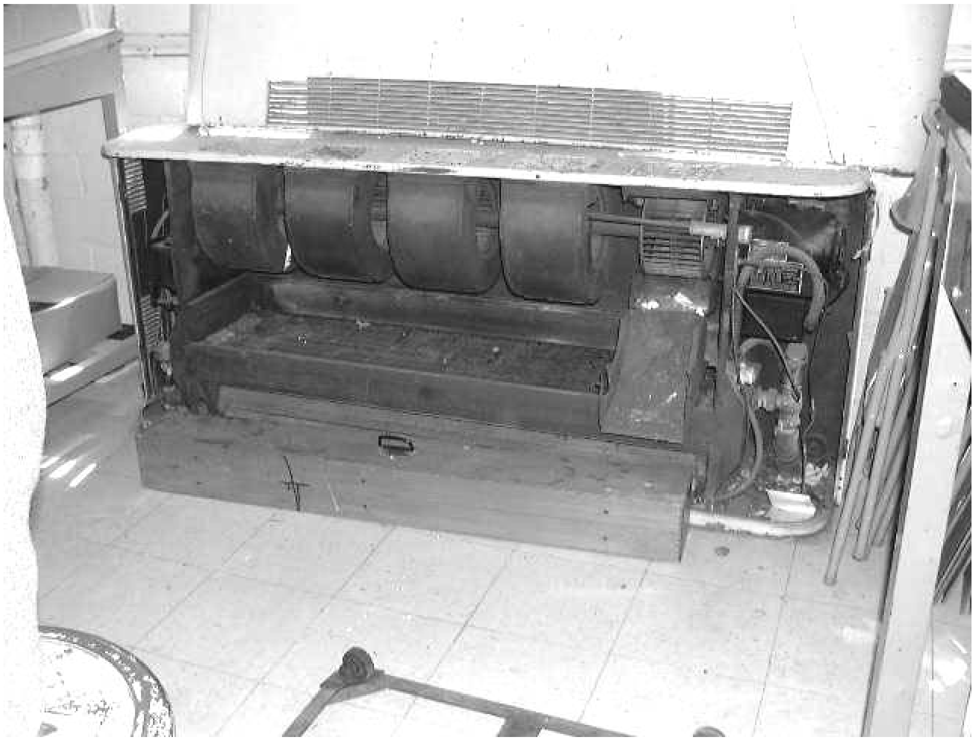
Figure 4 **Reconfiguration of Cosmetology Department to Enhance Exhaust Ventilation of Odors**



Picture 1

Example of Modern Classroom Univent

Picture 2

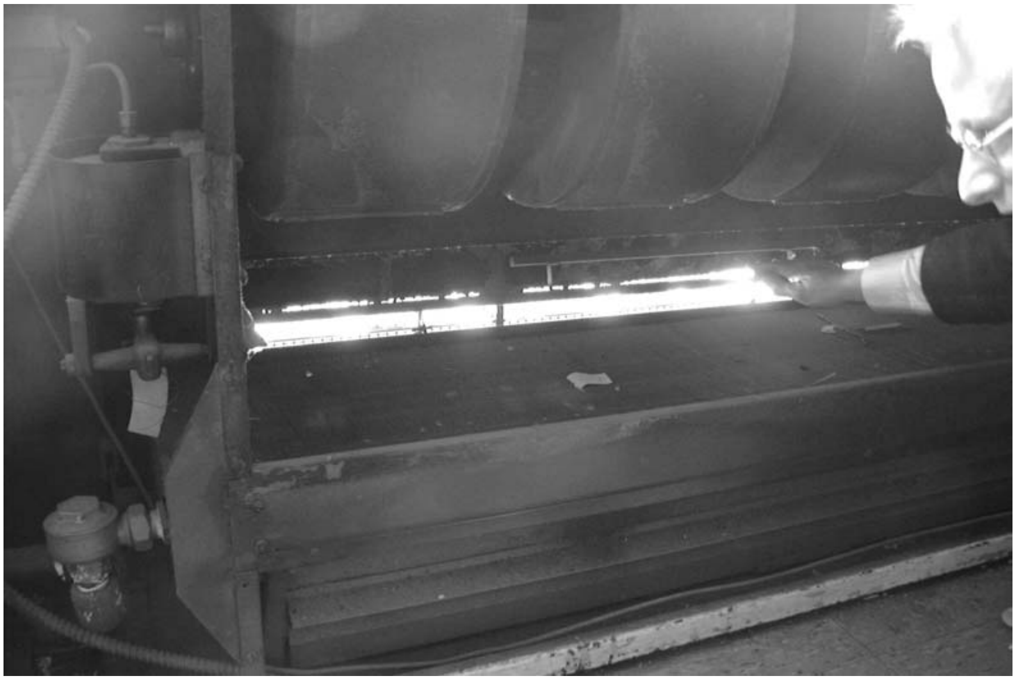


Vintage Classroom Univent Note Front Cover Removed

Picture 3

Univent Fresh Air Intake on Exterior Wall

Picture 4

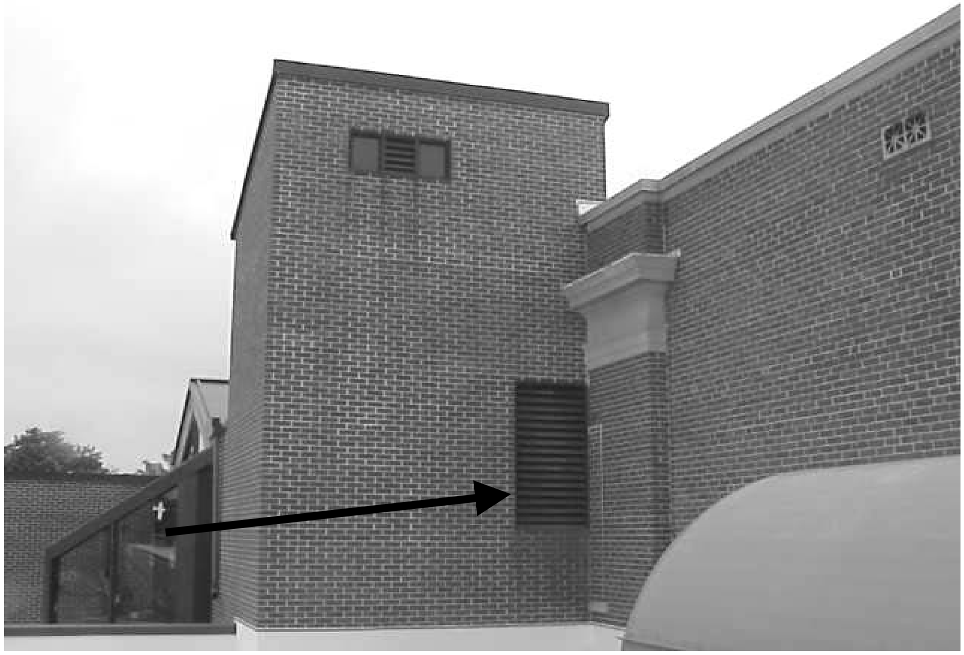


Interior of Vintage Univent in A-Wing, Note No Filters Were Installed In Unit

Picture 5

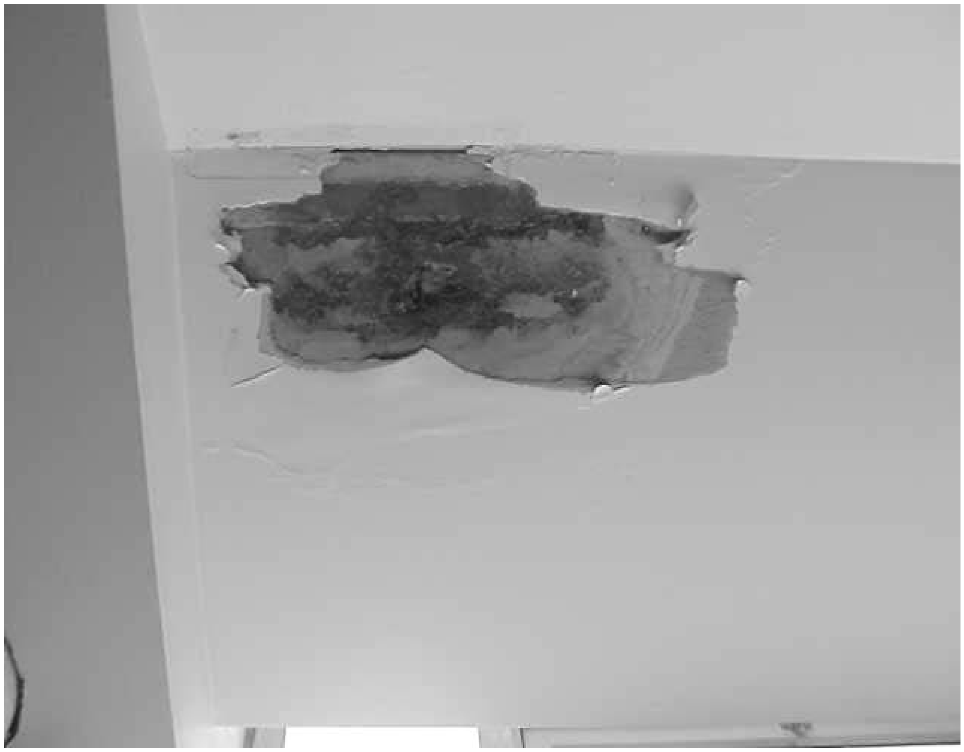
Classroom Gravity Feed Exhaust Vent, Note Hanging Pull Chain to Adjust Exhaust Flue

Picture 6



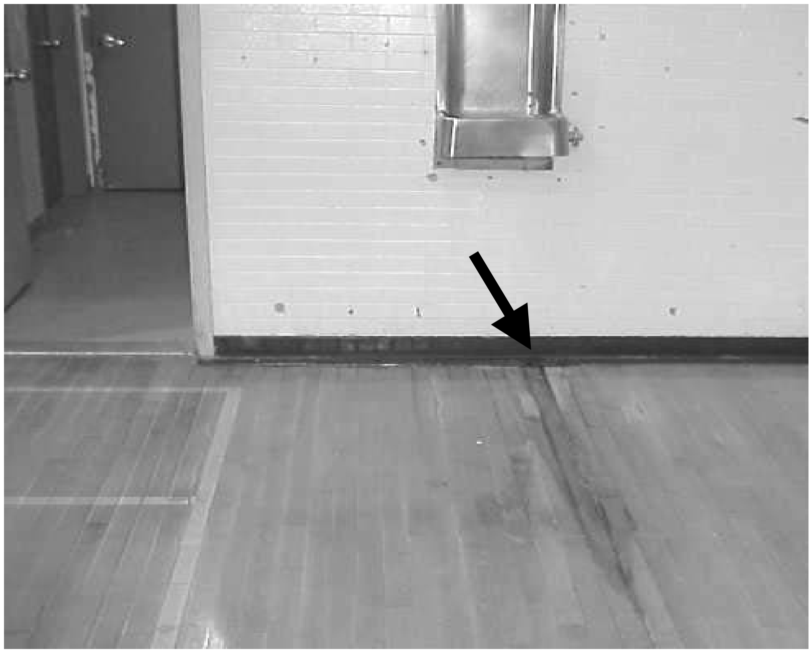
Fresh Air Intake Vent for the Health Department Office

Picture 7



Water Damaged Ceiling Plaster

Picture 8



Water Damaged Gymnasium Floor

Picture 9

Water Damaged Wall Plaster Indicating Moisture Penetration

Picture 10

Efflorescence on Exterior Brickwork Indicating Moisture Penetration

Picture 11

“Courtyard” Formed around Low-Lying Roof

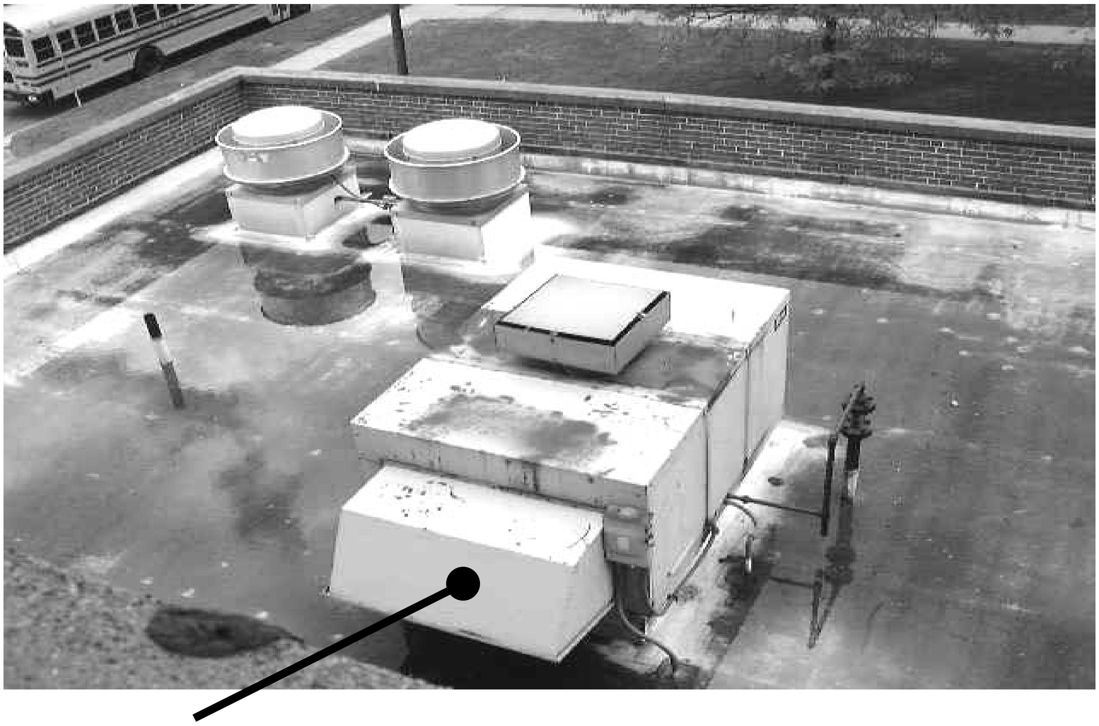
Picture 12

Accumulated Debris around Roof Drain Strainer

Picture 13

Water Pooling on Roof

Picture 14



AHU fresh air intake

AHU Unit Surrounded by Pooling Water

Picture 15

Water Accumulation at Bottom of Ramp, Note Water Damaged Wooden Door

Picture 16

Plants Growing in the Exterior Wall/Tarmac Junction

Picture 17

Inoperative Exhaust Fan in Kitchen Office

Picture 18

Damaged Metal Shop Exhaust Vent, Note Nesting Materials

Picture 19

Greenhouse Erected inside of Metal Shop

Picture 20

Configuration of Welding Exhaust Vent Ductwork

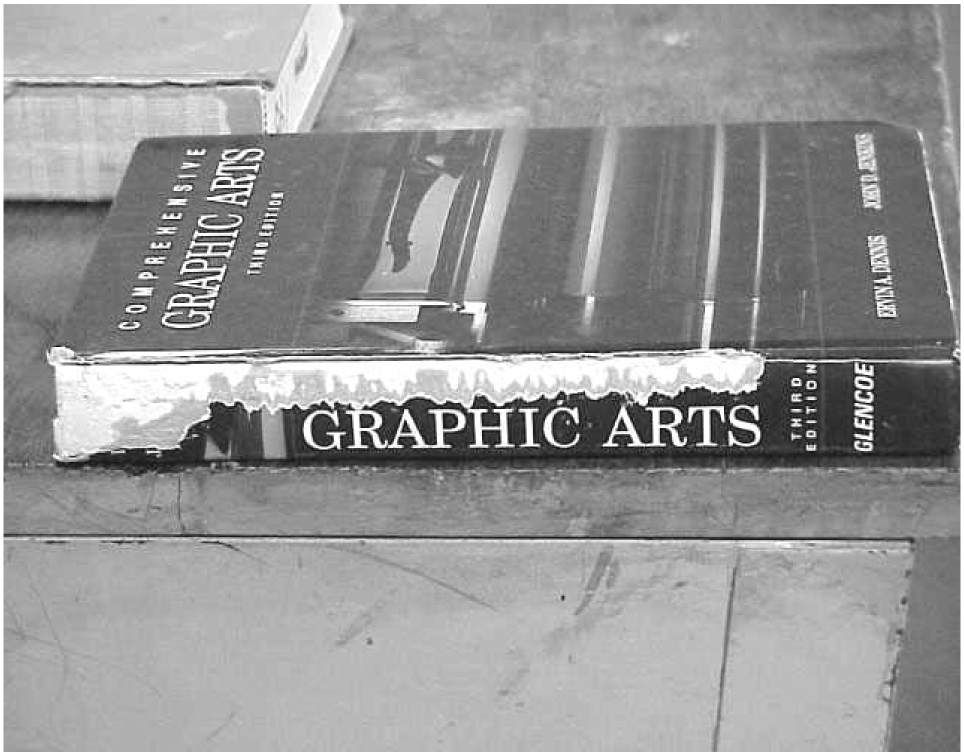
Picture 21

Corridor Formed by Floor Dividers in Cosmetology Department

Picture 22

Bird nest in the Roll Up Door of the Graphics Department

Picture 23



Book Binding in Graphics Department Eaten by Rodents

Picture 24

Yard Waste along Exterior Wall of Building

Picture 25

Dirt Pile along Exterior Wall of Building

Picture 26

Hole in Exterior Panel at Base of Building

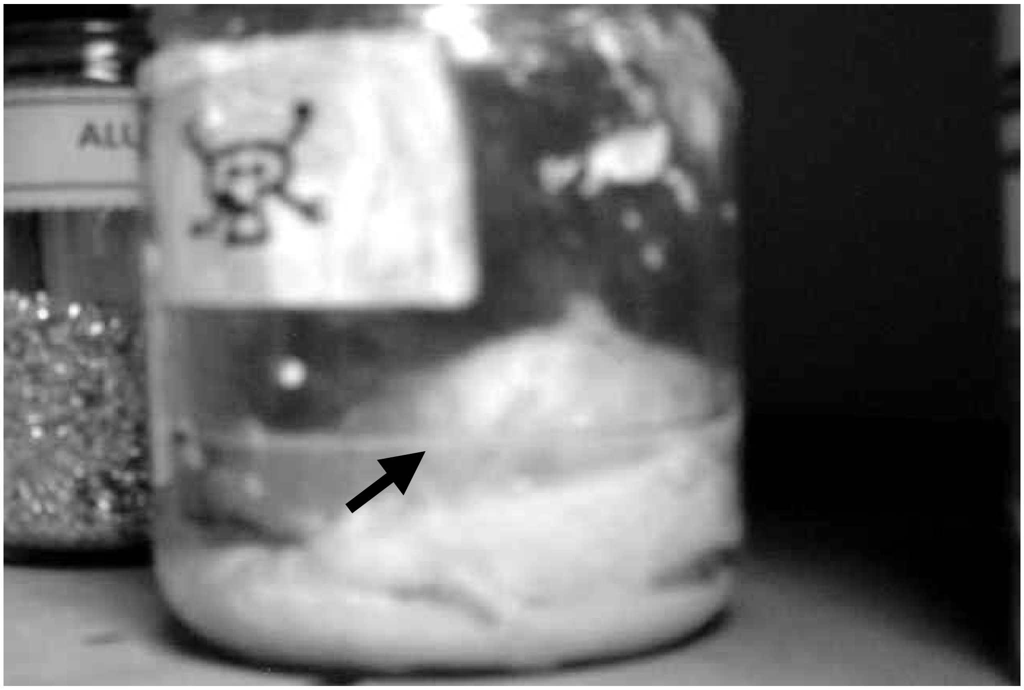
Picture 27

Food on Radiator in Cafeteria

Picture 28

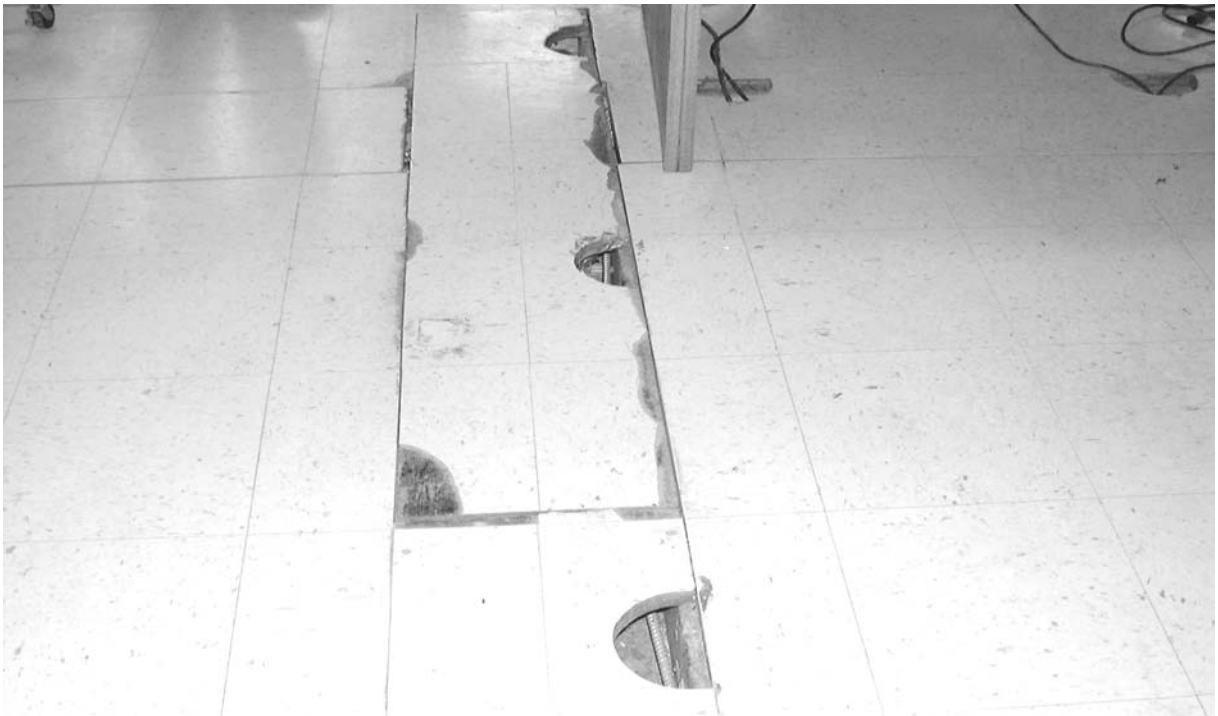
Plants growing in Front of Univent Fresh Air Intake

Picture 29



Container of Sodium Metal in Chemical Storage Area (E-Wing)
Note Exposed Sodium Metal above Liquid Line

Picture 30



Holes in Floor Tile in Computer Room A-304

Picture 31

Damaged/Broken Floor Tiles in Room above Print Shop/Graphics Area

Picture 32

Vehicles Parked in Close Proximity to Univent Fresh Air Intakes

Picture 33

Missing/Damaged Air Filters inside AHU in Gymnasium

Picture 34

Accumulated Chalk Dust in Classroom Chalk Tray

Picture 35

Abandoned Water Fountain in Gymnasium

Picture 36

Container with Floating Mosquito Eggs

TABLE 1

Indoor Air Test Results –Putnam Vocational Center, Springfield, MA – May 24, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation Intake	Ventilation Exhaust	Remarks
Outside (Background)	497	74	56					overcast/cloudy, thunderstorms, periodic downpours
C-Putnam's Pride Restaurant	789	72	67	~30	no	yes	yes	supply and exhaust off, carpet, efflorescence-wall, 7 CT, 5 ceiling tiles ajar, Men's/Women's restrooms-exhaust off
A-308	716	73	61	6	yes	yes	yes	univent off, exhaust-louver closed/grate missing, window open, water stained ceiling plaster, chalk dust
A-309	813	74	62	7	yes	yes	yes	univent off, window open, 11 cacti
A-312	949	73	62	13	yes	yes	yes	univent off, exhaust blocked by desk, windows open
A-313	1005	73	62	8	yes	yes	yes	univent off, window open, 3 plants, damaged ceiling plaster
A-314	957	73	59	7	yes	yes	yes	univent on, exhaust backdrafting, window open, 7 plants-no drip pans/on newspapers, water damaged ceiling plaster
A-315	1355	73	61	7	yes	yes	no	univent off, condensation between double paned windows, water

*** ppm = parts per million parts of air**
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 2

Indoor Air Test Results –Putnam Vocational Center, Springfield, MA – May 24, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
								damaged ceiling plaster, chalk dust, 18 computers
A-201	1127	73	58	4	yes	yes	yes	univent off-blocked by books/light fixture-reported blows cold air all winter, exhaust-louver closed/accumulated debris, broken window, plant, 2 computers
A-202	1077	75	58	15	yes	yes	yes	univent off-partially blocked, exhaust vent-no draw, window open, chalk dust, cleaning product
A-203	1068	75	62	17	yes	yes	yes	univent off, exhaust blocked by chalkboard, windows open-condensation, water damaged ceiling, utility holes, chalk dust, personal fan (off)
A-204	1093	76	60	10	yes	yes	yes	univent off, exhaust-louver closed, window open-condensation, utility holes, water damage, chalk dust
A-206	813	72	58	0	yes	yes	yes	univent off, exhaust off (small wall vent), window open, water damage around univent, chalk dust

*** ppm = parts per million parts of air**
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 3

Indoor Air Test Results –Putnam Vocational Center, Springfield, MA – May 24, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
A-207	1218	75	61	8	yes	no	no	window open, enclosed radiators-accumulated debris, water damaged ceiling, personal fan
A-209	847	76	59	7	yes	yes	yes	univent off, exhaust louver closed, windows open, utility holes, chalk dust, personal fan
A-210 Teacher's Room	1068	78	56	2	yes	no	no	2 photocopiers, coke/juice machines, coffee odor, restroom-exhaust on
A-105	1509	75	62	12	yes	yes	yes	univent blocked with books/desks, window condensation
A-103	1127	76	56	2	yes	yes	yes	univent and exhaust blocked, ~14 occupants gone 1 min., water damaged ceiling, chalk dust
A-101	674	75	56	2	yes	yes	yes	univent off, exhaust louver closed, 3-5 occupants gone ~5 min., water damaged ceiling, chalk dust, door open
A-306	1103	71	53	18	yes	yes	yes	univent off, exhaust off/backdrafting/accumulated debris inside, window and door open-condensation, water damaged ceiling-peeling paint, dust

*** ppm = parts per million parts of air**
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 4

Indoor Air Test Results –Putnam Vocational Center, Springfield, MA – May 24, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
A-304	1365	78	47	3	yes	yes	yes	univent off-covered with books, window open-condensation, 14 computers, utility holes on floor, damaged floor tiles, wall mounted a/c unit
-303	1038	76	51	6	yes	yes	yes	univent off-accumulated debris/dust, exhaust off, window open, chalk dust
A-302	1156	76	50	14	yes	yes	yes	univent off, exhaust off-backdrafting, window open-condensation, water damaged ceiling plaster, broken windows, active roof leak
A-301	1012	74	51	12	yes	yes	yes	univent and exhaust off-accumulated dirt/dust/debris in vents, window and door open, chalk dust
A-216	1219	73	54	9	yes	yes	no	window open-condensation, chalk dust, room divided in half with A-215
A-215	1790	74	55	7	yes	no	yes	window open, chalk dust, 18 plants-on paper towels, room divided in half with A-216
A-214	1450	77	51	17	yes	yes	yes	univent off-blocked by bookcase & file cabinet, window open-condensation, exhaust-weak, chalk dust, 6 computers

*** ppm = parts per million parts of air**
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 5

Indoor Air Test Results –Putnam Vocational Center, Springfield, MA – May 24, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Mediation Office	1520	76	52	4	no	no	no	time-released air-freshener
Assistant Principal's Office	1330	75	47	0	yes	no	no	active leak, water damaged wall/ceiling plaster
Assistant Principal's Office Restroom					no	no	yes	sink leak reported
A-212	1677	76	51	2	yes	yes	yes	univent and exhaust off, trash in univent-no filter-activated/spewed debris
A-211	1209	76	51	10	yes	yes	no	univent off, temperature complaints (cold), window open
Terrace Outside of A-212								bird nests/debris on terrace near air intakes-no filters
A-104	1250	76	50	7	yes	yes	no	univent off, window open, water damaged wall/ceiling plaster
Main Office	1136	77	50	7	yes	no	yes	window open, a/c unit, 7 computers, photocopier, planter on paper towel, water stained carpet, water damaged ceiling-peeling paint
Copier Room					no	no	no	2 photocopiers

*** ppm = parts per million parts of air**
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred 600 - 800 ppm = acceptable > 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 6

Indoor Air Test Results –Putnam Vocational Center, Springfield, MA – May 24, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
E.T.L. Office	1329	77	50	1	no	no	no	window mounted a/c, 4 plants
A-006	1350	77	50	0	yes	no	no	window mounted a/c-spaces-not sealed properly
E.T.L. #2	1368	76	53	2	no	no	no	
Vo-Tec Director's Office	1419	78	46	2	yes	yes	yes	univent and exhaust on, plant in standing water, photocopier
H-202 Carpentry	517	69	60	11	yes	yes	yes	univent and exhaust off, window open, saw dust, floor drain
	406	70	60	11	yes	yes	yes	window open
H-202 Classroom	501	70	60	0	no	yes	yes	univent off-deactivated, 4 CT, no thermostat
H-204	463	71	57	14	yes	yes	yes	floor drain
H-205 Autobody	449	69	63	6	yes	yes	yes	univent and exhaust off-deactivated, floor drain
H-206 Automotive	432	68	65	0	no	yes	yes	univent off, water fountain, floor drain
Horticulture	413	69	66	8	yes	yes	yes	

*** ppm = parts per million parts of air**
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 7

Indoor Air Test Results –Putnam Vocational Center, Springfield, MA – May 24, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Metal Shop	512	72	56	5	yes	yes	yes	univent and exhaust off
D-200 Electrical	808	72	51	1	yes	yes	yes	univent off
D-100	421	72	58	3	yes	yes	yes	

-

*** ppm = parts per million parts of air**
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 8

Indoor Air Test Results – Putnam Vocational Center, Springfield, MA – May 25, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
C-302 Drafting	650	78	27	3	yes	yes	yes	window open, univent and exhaust off, blueprint machine-ammonia
C-303	574	77	25	6	yes	yes	yes	window open, univent and exhaust off, univent blocked by desk-items on diffuser, chemical hood, 2 CT,
C-Wing 3rd Floor Hallway								4 CT
C-304	636	77	30	10	yes	yes	yes	exhaust off, chemical hood-operational, 1 CT, chalk dust
C-305	674	78	30	13	yes	yes	yes	window open, univent and exhaust off, items on univent, accumulated dust on exhaust vent, aquarium, loosely capped bucket of pig uteri under flow hood in cabinet-odors
C-306	711	76	33	13	yes	yes	yes	window open, univent and exhaust off, items on univent, missing/broken ceiling tile, chalk dust
C-307	635	75	34	1	yes	yes	yes	univent off-items on top, exhaust taped, dry erase board
B-Wing Men's Restroom (JROTC)					yes	no	yes	exhaust vent off, strong urine odors

*** ppm = parts per million parts of air**
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 9

Indoor Air Test Results – Putnam Vocational Center, Springfield, MA – May 25, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Main ROTC Room	553	69	56	2	yes	yes	no	window open, exposed fiberglass insulation, 1 out of 2 univents on, trash/debris in univent, cleaning products/latex paint under sink, ripped/stained couch/chairs
ROTC Office				0	yes	no	yes	exhaust off, window open
B-201	980	71	56	25	yes	yes	yes	univent and exhaust off, trash/debris in univent, window open
B-201 Storeroom				0	no	no	yes	missing/broken ceiling tiles, floor drain
B-202				0	yes	no	yes	5+ CT
1st Floor Men's Restroom – B-100				0	yes	no	yes	exhaust off, sink removed-abandoned pipe, exposed fiberglass insulation, urinal removed-pipe uncapped, pooling water on floor
B-100 HVAC	567	74	41	1	yes	yes	yes	1 out of 2 univents on-air diffuser covered with ??, metal grinding-no vent, oily rags/residue on shelf, gas cylinders stored on shelf-on side, air to air exchange

*** ppm = parts per million parts of air**
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 10

Indoor Air Test Results – Putnam Vocational Center, Springfield, MA – May 25, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
B-101	570	73	40	0	yes	yes	yes	mechanical parts on univent, 1 out of 2 univents on, univent blocked by refrigerator, hole in exterior door (~21/2" diam.), damaged fiberglass insulation
B-Wing Hallway								hole in exterior door (~2½" diam.), damaged fiberglass insulation
Girl's Restroom B-300					no	no	yes	exhaust off, floor drain-dry
Nursing Lab	945	76	46	0	yes	yes	no	univent off-return blocked, 8 CT, fire extinguisher not mounted on wall
SE Nursing Classroom	925	77	44	4	yes	yes	no	
E-201	775	77	37	0	yes	yes	yes	univent and exhaust off, window open
E-202	643	76	40	1	yes	yes	yes	univent and exhaust off, odors reported from Building & Properties (located below), 1 CT-painted, chalk dust
E-203	607	74	32	12	yes	yes	yes	univent and exhaust off, window open, 4 CT, chalk dust
E-204A	698	76	40	3	yes	yes	yes	univent and exhaust off

*** ppm = parts per million parts of air**
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 11

Indoor Air Test Results – Putnam Vocational Center, Springfield, MA – May 25, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
E-204	690	76	31	4	yes	yes	yes	univent and exhaust off, window open, fire extinguisher not secured
E-205	624	77	35	7	yes	yes	yes	univent and exhaust off, standing water outside window
E-205 Office				0	no	no	no	2 missing ceiling tiles, missing cinderblock-hole in wall, dry floor drain
Boy's Restroom-E-Wing 2nd Floor				0	yes	no	yes	window open, dry floor drain, exposed fiberglass pipe insulation
E-303	629	77	31	5	yes	yes	yes	univent and exhaust off, window open, 14+ computers, water damaged wall plaster/wooden windowsills, items on univent
E-304	674	76	31	16	yes	yes	yes	window open-condensation, broken ceiling tile, 12 computers, un-insulated copper pipe
E-305	601	76	29	9	yes	yes	yes	univent and exhaust off, window open-condensation, active roof leak, water damaged ceiling plaster, 7 CT, chalk dust
D-300 Library	721	70	35	2	yes	yes	yes	missing ceiling tile, 3 CT, univent off, photocopier

*** ppm = parts per million parts of air**
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 12

Indoor Air Test Results – Putnam Vocational Center, Springfield, MA – May 25, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Drafting	650	76	28	4	yes	yes	yes	univent and exhaust off, window open, 7 computers
C-Wing 3rd Floor Girl's Restroom					yes	no	yes	window open
C-301-Vice-Principal's Office	866	77	36	4	no	no	yes	exhaust off
Custodial Closet					no	no	no	uncapped cleaning products-odors, no exhaust vent
D-200 – Men's Restroom					yes	no	yes	exposed fiberglass insulation
D-200 (9th Grade)	921	76	37	3	yes	yes	yes	univent and exhaust off, window open
D-200 (10th Grade)	924	77	45	4	yes	yes	yes	pooling water on roof outside of univent air-intake, print shop exhaust vent outside window, items on univent
E-Wing 3rd Floor Girl's Restroom				0	yes	no	yes	window open, ceiling access open
E-301	840	75	40	11	yes	yes	yes	univent and exhaust off, window open-condensation, chalk dust, fuel/engine odors reported, temperature complaints-hot/cold

*** ppm = parts per million parts of air**
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 13

Indoor Air Test Results – Putnam Vocational Center, Springfield, MA – May 25, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation Intake	Ventilation Exhaust	Remarks
E-302	650	76	27	1	yes	yes	yes	univent and exhaust off, window open-condensation, 13+ computers, door open
A-Wing Sub-Basement								water on floor-pipe corridor/door to ramp, water damaged pipes
A-003	589	78	45	4	no	yes	yes	9 CT, 1 missing ceiling tile, items on univent-ducted through supply cage to outside (~5 bends), chalk dust, personal fan
Ralph's Supply Cage				0	no			snowblower in closet
A-001 Art Room	435	71	57	0	yes	no	no	kiln-local exhaust to outside, 5 plants, chalk dust, rubber cement, spray paints/adhesives
A-012 Art Room	775	72	65	15	yes	yes		window condensation, univent broken, ~10 plants, chalk dust, plaster of paris
A-011	776	73	61	10	yes	yes	yes	univent off-items on top, exhaust louvers closed, utility holes, chalk dust
A-010	782	74	57	8	yes	yes	yes	univent off-coats on top, exhaust vent behind shelving unit-no grate, chalk dust, exposed fiberglass pipe insulation, ammonia on shelf

*** ppm = parts per million parts of air**
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 14

Indoor Air Test Results – Putnam Vocational Center, Springfield, MA – May 25, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
A-008	637	74	57	7	yes	yes	yes	window open, univent off-return blocked by desk, exhaust off-2nd small exhaust vent drawing air-ungrated-reportedly blows cold air periodically, chalk dust, utility holes
A-007 Capaccino Café	872	73	56	~14	yes	yes		2 personal fans-on, ice machine, 5+ plants,
A006	850	72	60	10	yes	yes	yes	univent off-ducted out window, exhaust off, window open, utility holes, 3 plants
A005	857	74	59	11	yes	yes	yes	univent ducted out window-filled with debris, exhaust off, peeling ceiling paint, chalk dust
A004		74	53	4	yes	yes	yes	univent off-filled with debris/trash, exhaust off, window open-parking outside, chalk dust, peeling ceiling paint
C102	568	74	50	0	yes	yes	yes	univent off
Cosmetology-Prep Room	600	73	50	0	yes	no	yes	exhaust off, missing ceiling tile, reported odors from sink-holding tank, washer/dryer, computer, missing

*** ppm = parts per million parts of air**
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 15

Indoor Air Test Results – Putnam Vocational Center, Springfield, MA – May 25, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
								ceiling tile, holding tank-marble chips
Cosmetology (adjacent to C102)	478	74	39	6	yes	yes	no	univent off-debris, 3 windows open
Cosmetology	559	74	42	1	yes	yes	no	univent off, open food on counters
Cosmetology	565	74	37	4	yes	yes	no	univent off, window open, odors-nail polish
Nursing-Laundry Room				0	yes	no	yes	exhaust off
Nursing Office				0	yes	no	yes	exhaust off
Nursing Classroom SW	944	76	46	3	yes	yes	no	univent off
Nursing Classroom NW	889	77	44	0	yes	yes	no	univent off
Nursing Men's Restroom				0	yes	no	yes	exhaust off, dry drain
Music Room	960	77	41	0	yes	no	no	
Backstage of Auditorium	577	75	45	5	yes			feathers/bird wastes (stage left platform)

*** ppm = parts per million parts of air**
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 16

Indoor Air Test Results – Putnam Vocational Center, Springfield, MA – May 25, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Auditorium						yes	yes	univent off, water damaged ceiling/wall plaster
Auditorium Ladies Restroom					yes	no	yes	exhaust off
Health Center 5	718	73	48	0	no	yes	yes	univent and exhaust off
Health Center 4	771	75	47	0	no	yes	yes	univent and exhaust off
Health Center 3	681	73	44	0	no	yes	yes	
Health Center 2	682	73	44	0	no	yes	yes	door open
Health Center 1	780	73	46	1	no	yes	yes	univent and exhaust off
Health Center Lobby	786	72	44	2	no	yes	yes	elevator shaft
Multi-purpose Room	757	72	39	3	no	yes	yes	photocopier
Health Center 6	741	71	36	0	no	yes	yes	
Health Center	696	72	44	10	yes	yes	yes	univent and exhaust off, 6 water damaged/3 missing ceiling tiles,

*** ppm = parts per million parts of air**
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 17

Indoor Air Test Results – Putnam Vocational Center, Springfield, MA – May 25, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
								fiberglass
Print Shop	430	71	38	17	yes	yes	yes	univent and exhaust off
Copy Prep. Room Lay Out Area	495	73	37	5	no			
Gym	852	73	57	20+	no	yes	yes	univent and exhaust off, exhaust backdrafting, 20+ CT-possible mold, fountain drain, hole in wall
Gym Office Female	1015	75	49	0	no	yes	yes	supply and exhaust off
Gym Private Room						no	yes	exhaust off
Gym Office Male	881	75	50	0	no	yes	yes	supply and exhaust off
Boy's Locker Room	564	74	53	0	no	yes	yes	supply and exhaust off, floor drain, efflorescence
Girl's Locker Room	663	73	52	0	no	yes	yes	supply and exhaust off, floor drain, efflorescence
Weight Room	445	70	54	0	no	yes	yes	supply and exhaust off

*** ppm = parts per million parts of air**
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 18

Indoor Air Test Results – Putnam Vocational Center, Springfield, MA – May 25, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Cafeteria	736	72	62	7	yes	yes	yes	supply and exhaust off, window open, floor drain
Kitchen Office	834	73	59	0		no	yes	exhaust off, water damaged plaster, disinfectant
Health Center								3 CT
Copy Prep Area Computer Room	555	73	41	4	no	yes	yes	univent and exhaust off, 4 CT, door open
Copy Prep. Classroom	578	72	38	6	no	yes	yes	univent and exhaust off, 4 CT
D101 Commercial Art	600	73	37	7	no	yes	yes	univent and exhaust off, 10+ CT, water damaged ceiling plaster, door open
Cosmetology	570	74	36	18	yes	yes (6)	yes	1 out of 6 univents on, exhaust off

*** ppm = parts per million parts of air**
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 19

Indoor Air Test Results – Putnam Vocational Center, Springfield, MA – June 12, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Outside (Background)	435	64	63					
Auditorium	542	74	47	0	yes	yes	yes	gravity exhaust, univents off, bird wastes, upstairs-photo fixer/developer
Building & Property	623	76	48	7	yes	yes	yes	
Kitchen (past Cosmetology)	590	72	50	4	yes	yes		~12 plants
Kitchen (back)	710	73	55	~9	yes	yes	yes	washer/dryer, buckled ceiling tile, 2 missing ceiling tiles, occluded return vent
Main Office Photocopier Room				0	no	no	no	2 photocopiers
ETL	694	77	53	0	no	no	no	
Conference Room	706	77	47	0	no	no	no	
A113	590	75	48	4	yes	no	yes	exhaust louver closed, wall crack
A109	684	75	45	8	yes	yes	yes	univent off

*** ppm = parts per million parts of air**
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 20

Indoor Air Test Results – Putnam Vocational Center, Springfield, MA – June 12, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
A109-Principal's Office	780	75	38	1	no	no	yes	exhaust in adjacent restroom, window mounted air conditioner
ETL	740	76	43	6	yes	no	yes	exhaust in adjacent restroom, window mounted air conditioner
Counselor's Officer	1015	76	44	1	yes	no	no	
Vice-Principal's Office	617	76	43	0	yes	no	no	window and door open
A111	1156	76	40	3	no	no	yes	exhaust vent blocked, dry erase board, utility holes, 3 computers, photocopier, plants
Dr. Winkler's Office	1138	76	41	0	yes	no	no	3 plants-1 with corrosion on plastic drip pan, window mounted a/c-on
Mr. Akok's Office	1156	73	42	0	yes	yes	no	univent completely blocked, window mounted a/c-on, 2 plants, dry erase board
A104	599	70	55	6	yes	yes	yes	window open, dry erase board
Guidance Offices Main		75	55	5	no	no	yes	
Guidance-12th grade	761	76	49	0	yes	no	no	window and door open, 1 plant

*** ppm = parts per million parts of air**
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 21

Indoor Air Test Results – Putnam Vocational Center, Springfield, MA – June 12, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Guidance-9th grade	777	75	48	0	yes	no	no	window and door open, 3 plants
Guidance-9th grade (Andrews)	781	77	56	0	yes	yes	no	door open
Guidance-10th grade	802	77	49	1	no	no	no	door open
Guidance-11th grade	966	78	48	1	no	no	no	door open, heat complaints reported (no heat), complaints of poor carpet maintenance reported
Roof Notes								H-wing: 24 out of 48 vents on B/C-wing: 11 out of 18 vents on Gym: 1 out of 4 vents on Auditorium: 2 out of 2 vents on

*** ppm = parts per million parts of air**
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred 600 - 800 ppm = acceptable > 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

Table 22 TVOC Measurements in the Graphics Department

Area/Materials Tested for Evaporating TVOCs in Graphics Department	TVOC Concentration in parts per million (ppm)
Outdoors	0.3
Center of Room	0.6
Above Rinsed Out Printer Ink Well on Sink	1.6
Above a Printing Press	22
Above Parts Washer with Lid Open	198
Parts Washer with Lid Closed	1.8
Ink Storage Area with Caps Open	1.8
Photography Negative Examination Room	1.4
Graphics Computer Room	1.1
Dark Room	1.1
D-101 (classroom	0.4

Table 23 Decibel Measurements in the Carpentry Shop

Noise Source	Noise Levels in decibels (dBA)
Operating wood planer (within 2 feet)	108
Exhaust vent on wood planer (within 2 feet)	104
Hand Sander (within 5 feet)	90
Highest ambient (center of room)	82
Lowest ambient (balcony)	74

Table 24 Decibels Measurements and the Recommended Duration of Exposure

Noise Source	**Noise Levels in decibels (dBA) Measured in Wood Shop (dBA)**	**ACGIH TLV Recommended Duration per Day Time Intervals * (approximations)**
Operating wood planer (within 2 feet)	108	1.88 minutes
Exhaust vent on wood planer (within 2 feet)	104	3.75 minutes
Hand Sander (within 5 feet)	90	2 hours

* ACGIH, 1999

Table 25 TVOC Measurements in the Cosmetology Department

Area/Materials Tested for Evaporating TVOCs in Graphics Department	TVOC Concentration in parts per million (ppm)
Outdoors	0.3
Hallway Outside C100	0.3
Cosmetology Store Room	0.8
Cosmetology Washer/Dryer Room above Open Glass Jar of Barbicide®	44
Cosmetology Vanity Area-3 Open Glass Jars of Barbicide®	9
Cosmetology Nail Application Area over Nail Application Kit	9
Cosmetology Nail Application Area 2 inches over Open Bottle of Methyl Methacrylate Nail Application Kit	248
Kitchen Area outside Cosmetology	0.8
Cosmetology Area southwest corner	0.4
Cosmetology Area center of floor	0.4